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ABSTRACT

This study questions the developmental nature of the ability to understand syntactic structures. An exploration is made of the possibility of learning more about reading comprehension and readability by examining responses made to sentences described by transformational grammarians as structurally ambiguous. A group of fifth grade students were asked to identify paraphrases of three kinds of sentences, ones with ambiguous surface structure, ones with ambiguous underlying structure, and ones considered to be unambiguous. (An example of a sentence with ambiguous surface structure is, "Small boys and girls are easily frightened." An example of a sentence with ambiguous underlying structure is, "Flying planes may be dangerous.") Although the fifth graders did not do well on the test, the order of difficulty of items was found to be similar to that found by other researchers. The order of difficulty ranged from unambiguous sentences as easiest, to surface structure ambiguities as next in difficulty, and underlying structural ambiguities as most difficult. Oral interviews with eight of the students after they took the test resulted in improved scores. A comparable study by Montague is reviewed and similarities in research findings are noted. (MKM)

STRUCTURAL AMBIGUITY

AND

READING COMPREHENSION

Paper presented at the Second

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Introduction and Statement of Problem

In 1917 Thorndike made the very simple but very true statement that reading comprehension is "a very complex procedure" and for 50 years after that research primarily focused on various aspects of word identification rather than comprehension with, of course, the occasional major exception.

In 1969, John Bormuth, writing in Psycholinguistics and the Teaching of Reading, condemned much of the research into comprehension in these words:

> "Nearly all this research and virtually all the instruction are based upon a conception of comprehension which is faulty and so subjective and nebulous that it is more misleading than helpful (p. 48)."

Strong words, but in part understandable, for reading comprehension does involve complex mental processes with little or no overt behavior being produced. However, although the mental processes are not directly observable the input to them often is and in the vast majority of cases this means the language of print. Aided by the work of linguists and especially of transformational - generative grammarians who provided a competence theory about the nature of language based on the word of Chomsky, reading researchers began to see the necessity for careful analysis and extended research on the definable aspects of the input to the mental processes involved in reading comprehension in order to be able to analyse the processes themselves with any hope of success.

One such aspect, the syntactic structure of written language, had

long been acknowledged to play a major role in the readability of written language and a number of researchers including Bormuth himself, showed that reading comprehension is inextricably tied to the structural framework of sentences and they identified various elements within the structure that affected the ease or the difficulty of comprehending written language. In view of all the evidence to support the inclusion of sentence structure as a factor in reading comprehension it was felt necessary to find a suitable way of measuring this factor, of determining just how well individual students can understand the syntactic structures by which language signals information. Attempts to do so were notably lacking and those attempts that had been made were generally inconclusive. The problem was largely one of finding a vehicle upon which to construct such a measure for in the reading situation understanding of syntactic structure implies understanding of the ways in which these structures convey information. The vehicle had to be composed of written language, it had to minimize the vocabulary knowledge aspects of reading, which obviously cannot be totally eliminated, and it had to be capable of reflecting the developmental nature of the ability to understand syntactic structures. Fortunately, it seemed, and this brings me to the major focus of this presentation, recent work in transformational - generative grammar and psycholinguistics suggested such a vehicle - the structurally ambiguous sentence.

Ambiguity - Definitions and Research

Firstly what is a structurally ambiguous sentence and secondly why did this seem to me to be a viable means of measuring the child's awareness of syntactic structure?

Ambiguity exists when any stimulus pattern is capable of 2 or more

distinct interpretations and this forms the basis for much of our humor.

Structural ambiguity exists when in linguistic terms an orthographic form has two distinct phrase markers associated with it.

Overhead - Flying planes may be dangerous
#1

a. (((Flying) (planes)) (may be dangerous))
S NP N N NP VP S

b. (((Flying) (planes)) (may be dangerous))
S NP V NP NP VP S

The string 'Flying planes may be dangerous' can be considered to have at least two meanings depending upon the structural relationships identified with it. The ability to recognize that a sentence such as this is ambiguous or even to be able to identify the ambiguity in the sentence when given two interpretations of it seems to imply an ability to understand the two possible syntactic relationships in the sentence.

Moreover, the ability to recognize ambiguity in language has become an almost canonical example in the linguistic and psycholinguistic literature of a characteristic of a mature user of language and, if this is the case, when and how does this ability develop?

Also, the concept of structural ambiguity seemed viable because the difficulty of the vocabulary in the sentence containing the ambiguity could be altered to correspond to different levels of vocabulary knowledge without altering the syntactic relationships in the sentence. Thus, it seemed that a vehicle was indeed available.

Some previous work had already been conducted using structurally ambiguous sentences, most of it with adults. What this primarily showed was that adults responded differently to two major types of structural ambiguity. These two types were classified as surface structure ambiguity and underlying

structure ambiguity according to current thinking in the field of transformational - generative grammar.

Ambiguity at the surface structure level, it was claimed, involved the possibility of two distinct groupings of adjacent words e.g.

Overhead
#2

a. Small boys and girls are easily frightened.

b. The choice of the students was announced.

If "small" is grouped with "boys and girls" then obviously both the boys and the girls are small, and likewise if "small is grouped only with "boys" then only the boys are small. Such a sentence involving two obviously distinct groupings of adjacent words would be considered to be structurally ambiguous at the surface structure level.

So-called underlying structure ambiguity, represented in Sentence 2, is more difficult to explain and Dr. Prideaux will doubtless have something to say about this later, but it was traditionally defined as involving a change in the logical relations between words rather than a change in the apparent grouping of words. For example, in the sentence 'The choice of the students was announced', the noun phrase the choice of the students can be seen as originating in either of two underlying structures: either that the students chose someone (or something) or that someone chose the students. In 1972, while I was conducting my research, Dr. Prideaux made the claim that both types of structural ambiguity were, in fact, the same in that they could both be resolved at the level of surface structure by means of labelled bracketing. However, the important thing from my point of view in terms of reasons for distinguishing these two types of ambiguity was that significant differences had been found by MacKay (1966) and by MacKay and

Bever (1967) in the time that it took adults to discover the ambiguity with so-called surface structure ambiguities being discovered consistently faster than underlying ambiguities.

Prior to 1972, only one major study that I am aware of attempted to explore the ability of children to recognize ambiguity in sentences. This was by Sister Jurgens at George Peabody College in 1971. Her subjects were children in grades 7, 9, and 11 and while there are a number of limitations that make it difficult to apply her findings to reading comprehension, she did conclude,

> "The data for correct-response scores quite readily suggest that maturation of the ability to perceive ambiguity at different linguistic levels may follow a distinct developmental pattern ..... ability to perceive surface structure ambiguity seems to develop earlier than the ability to detect underlying ambiguity (pp. 70-71)."

Little's 1972 Study

(a) Purpose and Design

The purpose of my study in 1972 was firstly to attempt to discover the relationship between the ability to identify ambiguity and reading comprehension ability, and secondly to shed some light on the value of using the structurally ambiguous sentence as the basis for a possible measure of the child's linguistic competence as it relates to his reading comprehension of syntactic structures.

The primary testing instrument that I devised was called the Sentence Interpretation Test and the items in it were like this:

Overhead
#3

BOYS LIKE ICE CREAM BETTER THAN GIRLS	GIVES A MEANING	DOES NOT GIVE A MEANING
(a) It is ice cream that boys like better than they like girls	_____	_____
(b) Boys like ice cream better than girls like boys.	_____	_____
(c) Boys like ice cream better than girls like ice cream.	_____	_____

Sample SIT Item

There were 40 items: 10 with surface structure ambiguity, 10 with underlying structure ambiguity, and 20 which were unambiguous. For each of the 40 lead sentences, 3 interpretative sentences were constructed, of which 1, 2, or all 3 gave a meaning of the lead sentence.

The construction of the lead sentences was based on an analysis of the structurally ambiguous sentences used by MacKay, MacKay and Bever, and Jurgens. This analysis proved quite revealing and showed that the types of syntactic structures in which the ambiguity was located differed absolutely between those sentences classified as having surface structure ambiguity and those classified as having underlying ambiguity.

Overhead
#4

a. Structure Characteristic of Surface Structure Ambiguity

1. Adj + N + N - he was an American art expert.
2. Adv/Adj - the blue dress particularly interested her.
3. Prep Phrase - he painted the picture on the patio.
4. Adj + N_1 + and + N_2 - little cats and dogs like to go exploring.

5. N_1 + N_2 - he told her baby stories.

b. Structure Characteristic of Underlying Structure Ambiguity

1. Infinitive - the lamb is too hot to eat.
2. Ving + N - he disliked visiting relatives.
3. Genitive - the manager's selection was announced.
4. Infinitive + Ving - he asked the teachers to stop smoking.
5. Comparative Deletion - boys like tennis better than girls.

4a. Structures Characteristic of Surface ambiguity

1. The element N + N may be interpreted as a compound noun, in which case the Adj modifies the second N in the compound, or both N's are distinct, in which case the Adj 'American' modifies the first N 'art'.
2. 'particularly' may function as an Adv or an Adj.
3. The prep. phrase 'on the patio' may modify a proceding noun or a preceding verb.
4. The Adj here may be interpreted as modifying only N, 'cats' or, by a common-elements deletion transformation, as modifying both N_1 and N_2 'cats and dogs'.
5. One noun immediately following another in a terminal string may be interpreted as either a compound noun or two separate nouns.

4b. Structures Characteristic of Underlying Structure Ambiguity

1. The infinitive 'to eat' may be interpreted as transitive with an unspecified object 'to eat something' or as intransitive with 'be' deleted 'too hot to be eaten'.
2. V + ing may be interpreted as part of a verbal 'disliked visiting' or as an adjective modifying the following noun 'relatives'.
3. The genitive 'manager's selection' may be interpreted as deriving from an

underlying structure of the form 'That the manager was selected'.

4. V + ing may be interpreted as part of the verbal containing the Infinitive or as a nominalization which functions as the object of the Infinitive.

5. Where the deleted elements in a comparison may be interpreted as being either the Subject + Verb of the sentence or the Verb + Object of the sentence.

The sentences were balanced syntactically such that, for example, a sentence containing an ambiguity in one of the structures characteristic of surface structure ambiguity also contained an unambiguous instance of one of the structures characteristic of underlying structure ambiguity. As for example the sentence 'Little cats and dogs like to go exploring' contains an unambiguous instance of the structure Infinitive + Ving which is a structure characteristic of underlying structure ambiguity. The sentences were controlled for length (8 words + or - 1), for vocabulary content, and also for grammatical and semantic acceptability - this latter by having a panel of graduate students assess each sentence. The reliability was later calculated at .839.

So this test, the Sentence Interpretation Test, was constructed to measure the ability to identify ambiguity. The Reading comprehension of the students was measured by a standardized test, Level 2 of the Stanford Diagnostic - Reading Comprehension Subtest which provided three scores, a score on literal comprehension, a score on inferential comprehension and a total comprehension score.

The experiment was conducted with 60 Grade 5 students as this seemed a likely starting place in view of data from other studies and in view of

the fact that by this time word identification should have ceased to be a major concern for them and they would have received some formal teaching of comprehension. These 60 students (30 boys and 30 girls) were selected on the criteria that (1) they were native speakers of English, (2) they were of average reading ability according to school administered standardized tests, and (3) they were of average intelligence so that their scores would not be affected by a low intelligence quotient.

The testing was conducted in a three day period - 20 students at a time and the data were analysed by correlations and by 2 - and 1 - way analyses of variance with repeated measures.

(b) Results

Overhead #5

MEANS AND STANDARD DEVIATIONS FOR THE SIT

SIT Scores	Possible Score	Mean Score	Standard Deviation
Total Test	40	17.78	5.84
Unambiguous Sentences	20	11.97	3.57
Ambiguous Sentences	20	5.85	3.29
Surface Structure Ambiguities	10	3.48	2.00
Underlying Structure Ambiguities	10	2.37	1.80

It was fairly obvious that average readers at the grade 5 level had not adequately acquired the ability that the test was designed to measure. Even scores on the unambiguous sentences were lower than the pilot study had suggested they would be and it seemed that students at this level had difficulty in even identifying paraphrases.

However, a rank ordering of difficulty that proved to be statistically

significant did emerge with unambiguous sentences being the easiest, followed by those with surface structure ambiguity and finally those with underlying structure ambiguity, which tended to confirm the findings of MacKay etc.. These data certainly seemed to suggest the need for more intensive teaching of the ways in which syntactic structures help convey information.

Significant correlations were found to exist between the ability to identify the meanings of ambiguous and unambiguous sentences and reading comprehension ability with the most consistent relationship existing when scores on inferential reading comprehension only were involved. Structural ambiguities are not always easily resolved by regrouping the words in the string and it seems to require a certain linguistic competence. Likewise, inferential comprehension involves understanding of more subtle relationships than does literal comprehension. It may well be that instruction in those aspects of language measured by the SIT would help to improve the inferential comprehension ability of at least grade 5 students.

The data also suggested that I.Q. was an important factor in the abilities measured and interestingly, girls scored consistently higher than boys on all aspects of the SIT.

(c) Interview Data

The second part of this study involved an interview with 8 students who were selected to represent extremes of performance on the reading comprehension test and the SIT. The purpose was manifold - to retest certain items and thus determine if individual administration made a difference; to see if these students differed in their responses to structurally ambiguous sentences when asked to orally describe the meanings rather than to classify paraphrases; to see what effect context had on their understanding of certain sentences; and to observe and record the students general observations on

the test.

Retesting involved 6 items for each student that he or she had originally answered incorrectly - 2 each of unambiguous, surface, and underlying. On the retest 81% of the previously incorrect responses to the unambiguous sentences were corrected. Individual administration certainly made a difference here. 35% of the ambiguous sentences were corrected but 56% drew exactly the same incorrect response. It seemed that the sentences had a preferred meaning for most students and that this preferred meaning prohibited many of them from identifying the other meaning despite the aid of the interpretative sentences. Although the test was constructed to highlight the role of syntax in conveying meaning and to minimize the semantic aspect it certainly seemed that semantics were playing a larger part than had been anticipated.

These students were also given 20 additional sentences constructed in the same way as for the SIT and asked to silently read each one in turn and then to explain its meaning in their own words. They were then asked if the sentence could have any other meaning. Their ability to detect and explain ambiguity in this way was again no better than it had been on the SIT. However, semantic considerations were again obviously playing a major role. For example, one boy explained the two possible meanings of the sentence "Peter's mother looked at the girl with the telescope" but then totally discarded one interpretation with the comment "that's stupid, she wouldn't look at the girl because a telescope is to look at the universe with". Another student, faced with the sentence "Old men and women like to go visiting" said that "Well, it could mean old men or it could mean old men and women, but it must mean old men and old women because it's only old people who like to go visiting anyway."

A further aspect of the interview involved putting two of the

ambiguous sentences in 4 separate paragraphs so that only one of the possible meanings could hold true according to contextual constraints. This was obviously an extremely limited aspect of the study and conclusions were perhaps more subjective than objective, but it was interesting to note that all but 2 of the 8 students interviewed showed some misunderstanding of these sentences in context. For children such as these, in the acquisition stage of reading, the problems of interpretation that ambiguous sentences create may rely heavily for their solution on syntactic and semantic information. It is, however, the lack of these very factors that charactizes the reader in the acquisition stage. Basal readers, text-books, newspaper and so forth contain many structural ambiguities and unless the reader has a fairly good awareness of contextual constraints on meaning, he may easily misinterpret the message.

Montague Study

(a) Purpose and Design

It was obvious that further research was needed to determine the relationship among the variables described here and some was in fact conducted by Mikell Montague in 1973 as a thesis for her Masters Degree.

Her purpose was to determine whether the ability to identify structural ambiguity continued to develop in students from grade 5 to grade 6 and from grade 6 to grade 7 and to further explore the relationship between this measure of linguistic competence and reading comprehension. In addition she also attempted to measure the related language skill of successfully 'disambiguating' structurally ambiguous sentences when they were embedded within paragraphs which allowed only one of the possible meanings to hold true. She defined 'disambiguate' as "the ability to select the one paraphrase

of an ambiguous sentence which is suitable for the contextual paragraph in which it has been embedded".

The testing instruments she used were the SIT with some minor modifications, Level II of the SDRT - Reading Comprehension Subtest, the Lorge Thorndike Intelligence Test, and a new test which she constructed called the Contextual Ambiguity Test or CAT. The CAT consisted of 20 paragraphs - 10 containing a sentence with surface structure ambiguity and 10 containing a sentence with underlying structure ambiguity. After each paragraph were 3 interpretative sentences and the students had to decide which of these sentences gave or did not give a meaning of the underline sentence in the paragraph. These paragraphs were controlled in a similar way to the SIT for vocabulary and for length and were also written to sound as natural as possible. Montague's sample consisted of 30 students (15 boys and 15 girls) in each of grades 6 and 7 who met the same criteria of language background, reading ability and I.Q. established for the sample in my study.

Montague also included an interview in her study for the same basic reasons as I had included one in mine. She administered all tests herself and analysed the data by correlation and by 2 - and 1 - way analyses of variance. So the design was extremely similar.

(c) Findings

The findings of Montague's study for grade 6 students showed that these students were indeed better able to identify ambiguity on the SIT than were the grade 5's although mean scores were not that much higher, especially for underlying structure ambiguities. Again, the order of difficulty for the sentence types was the same for grade 6's as for grade 5's and there was a significant positive relationship between reading comprehension and

the language abilities measured by the SIT and the CAT. Moreover, these students were better able to cope with ambiguity when the structures were embedded in paragraphs than when they appeared in isolated sentences. It should be noted, however, that again correct scores were not high and Montague made the point that perhaps context alone is not sufficient for a reader, at this level at least, to deal successfully with ambiguous structures.

The Grade 7 data were considered by Montague to be invalid as all of the students interviewed admitted to her that they had not take the language tests seriously having been told that they would not be counted in their marks.

However, her total data led to the following general conclusions:

1. Those aspects of linguistic competence measured by the SIT and the CAT are significantly related to reading comprehension although on the basis of the data no claims can be made that there is a higher level of significant correlation either for inferential or for literal comprehension.
2. When processing sentences in isolation by means of selecting correct paraphrases of that sentence, unambiguous sentences are far easier than ambiguous sentences and ambiguous sentences with surface structure ambiguity are easier than those with underlying structure ambiguity.
3. There is evidence of a developmental acquisition of the skills involved in identifying ambiguity at least between grades 5 and 6, but the development appears to be occurring at a fairly slow pace.
4. Although not a categorical statement, it seemed that in context underlying structure ambiguities are more easily disambiguated than surface structure ambiguities. This seems to raise the whole question of how in fact

ambiguous sentences are processed when they occur naturally in context. It has been suggested either that only one meaning is processed and accepted until it is found to be inadequate or that both meanings are processed and one is suppressed by context. Although the data so far available do not clarify the process issue they do suggest that perhaps different processes or maybe different levels of the same process are involved in dealing with sentences in isolation as opposed to sentences in context.

By way of conclusion I would like to draw some general implications arising out of these studies that I believe are pertinent to the teaching and to the learning of reading and also to the general theme of this session - linguistic theories and reading research.

1. If grade 5 and to lesser degree Grade 6 students do not generally exhibit the ability to understand the ways in which syntactic structures convey information at least in the way in which it was assessed in these studies, and if such an understanding is as important to reading comprehension as has been suggested, then perhaps we should be placing much more emphasis on the teaching of language structures in the program for upper elementary school children. The common practice of teaching the names of parts of speech, a linguistic metalanguage, is not what I am referring to, but rather students need to understand how the structuring of sentences affects the relationship of one word or phrase to another. Of prime importance it would seem, is to convey the concept that the structures of language are flexible, viable phenomena that operate according to certain rules and that can be manipulated to convey meaning in various ways.

2. Both Montague and myself found that structurally ambiguous sentences occur in all types of reading matter - from primers to doctoral dissertations. Adult, mature readers are not easily aware of them probably because of their awareness of contextual constraints on meaning but children, who are not proficient readers and who are not fully aware of such contextual constraints, can easily fail to identify the correct meaning of these ambiguous structures. Teachers, authors, and teachers as authors of tests etc. need to be aware of structural ambiguity and to make provision for it.

3. As mentioned at the beginning of this presentation, structural complexity has long been a concern of reading researchers and obviously rightly so. Transformational - generative grammar has offered a very appealing and a very precise means of analysing written language and as such has raised the hopes of researchers in reading that precise statements can be made about the ways in which syntactic structures help or hinder in conveying information. However, the data seem to be suggesting that although there are attempts, and generally scientific attempts, at assessing a child's linguistic competence as it relates to his understanding of structure, our knowledge of the processes involved is still at a very elementary level and perhaps, too, the linguistic theories upon which so much research in reading has recently been based are not necessarily the ultimate answer. Semantics and syntax obviously cannot be divorced entirely and perhaps the research mentioned here is suggesting that at our present state of knowledge they cannot yet be separated with sufficient clarity to make any categorical statements at least about the syntactic element.

4. Finally, and perhaps very simplistically, it is becoming increasingly

apparent that Reading is not a field of study unto itself alone. Nor for that matter, I would think is Linguistics. Both deal with language - with phonology, with syntax and with semantics - and hopefully reading teachers, reading specialists and reading researchers will avail themselves of the ever-growing and scientific body of knowledge that linguists are able to offer.

I think we have to still agree with Thorndike that reading comprehension is a very complex procedure but hopefully Bormuth's condemnation that nearly all the research is subjective and nebulous no longer holds true.

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